10 Wildland Fire Management Situation

FIRE SEASON AND HISTORICAL WEATHER SUMMARY

The fire season, as determined by the fire program and budget analysis (FIREPRO), runs from May 15 to October 15, with an average of 50 to 100 fires of all origins occurring during this period. July, August, and September have the highest fire incidence. Weather tends to be clear with daytime temperatures ranging approximately 75° to 85° F at 5,000 feet in elevation and 85° to 105° F at 1,000 feet. Prevailing winds are about five to ten miles per hour from the west and southwest.

The prevailing westerly wind brings marine air into the San Joaquin Valley that is heated and subsequently raised by the steep rise of the Sierra to the east. As a result, afternoon thunderheads are common during the hottest weeks of the year, from mid- July to the end of August. At other times of year, thunderstorm activity is generated by flows of southerly subtropical moisture. Periods of high lightning activity often last three to four days, possibly igniting 10 to 20 or more fires in the 4,000 to 8,000 foot elevations of the parks during one of these periods.

The parks receive their precipitation, depending on elevation, almost entirely from winter cold-front passages from the northwest and west. Virtually no precipitation occurs during the summer and fall, except during thunderstorms. Rarely, tropical storms from the Gulf of Mexico drop as much as four to six inches of rain in a few days during the summer and fall.

The topography of the parks results in a variety of local wind conditions. The diurnal relationship between heating and cooling of slopes and canyons results in local winds that can become significant to fire behavior. Narrow canyons, such as the South Fork of the Kings at Cedar Grove, typically produce summer afternoon up- canyon winds of 10 to 20 mph. Steep slopes result in nighttime down- slope and down- canyon winds. The occurrence of mid- slope thermal belts is common from mid- July to mid- October and can result in fires actively burning well into the night.

Thunderstorms can produce strong, erratic downdraft winds, which follow topographic features and can cause rapid spread of fire in all directions. Another potential source of strong winds is the rare foehn- like mono wind of late summer and fall. These gale force east winds are warm and dry, originating from the Great Basin. The high mountain crests of the Great Western Divide and High Sierra usually prevent these strong winds from reaching the surface within the parks. When these systems are well established, the strong and dry east winds aloft are frequently accompanied with extremely dry conditions and poor nighttime humidity recovery. Maximum relative humidity may not exceed 25% and can actually go down to single digits over night.

The predominate summer weather scenario consists of a high pressure system that settles over the western United States and produces good visibility, high temperatures, low humidities, and atmospheric instability with gusty winds. Relative humidities in the mid- teens and low- twenties are common during these long periods of strong high- pressure dominated weather.

There is some speculation that oscillation in the relative humidity in these parks results from fluctuations in the boundary between the moist marine layer to the west and the dry high-pressure area to the east. As a result, prescribed conditions can disappear quickly, and nighttime humidity recovery may be less than expected when the high pressure dominates.

The atmosphere tends to be unstable during the spring and becomes more stable during the fall. The San Joaquin Valley develops an inversion during the fall as the atmosphere cools, and agricultural "no burn" days below 5,000 feet are common. As the atmosphere over the parks becomes more stable, the probability that smoke will impact a popular vista or a local community becomes more likely.

Steep canyons also develop strong inversions, leading to potentially explosive conditions when they lift, as demonstrated by the 1976 Sphinx Fire in Bubbs Creek canyon in which several hundred acres of brush and timber burned up in the early afternoon of June 29. Smoke in these canyons also affects aviation operations, with smoke not lifting until around 10:00 a.m.

WILDLAND FUELS AND FIRE BEHAVIOR

Fire in the Sierra Nevada plays an important role in determining the structure of the various vegetation types. Each vegetation type has evolved in the presence of a distinct fire regime. The vegetation of the parks generally changes along an elevation gradient. In general, the vegetation types, elevations, behavior, and corresponding fuel models are:

Table 10-1 – Vegetation Types, Elevations, Fire Behavior, and Fuel Models

Vegetation Type	Elevation Range	Fire Behavior	NFFL Model	NFDRS Model
Grassland (montane meadows, etc.)	6,000-11,000'	Rapid Spread Low Intensity	1	L
Grass with Overstory	1,400-6,000'	Rapid Spread Moderate Intensity	2	C
Tall Brush (chamise & manzanita)	1,400-5,000'	Rapid Spread High Intensity	4	B
Low Brush	1,400-6,000'	Moderate Spread Moderate Intensity	5	F
Medium Brush (decadent)	6,000-10,000'	Rapid Spread Moderate Intensity	6	F
Closed Timber (short needle – slow spread)	5,000-11,000'	Slow Spread Moderate Intensity	8	H
Broadleaf Deciduous Hardwood & Long Needle Pine	4,500-7,000'	Moderate Spread, Moderate Intensity	9	W, E
Heavy Timber Litter	4,500-8,000'	Moderate Spread High Intensity	10	G
Low Elevation Short Needle Conifer (SEKI custom model)	6,000-10,000	Slow Spread Moderate Intensity	14	G
High Elevation Short Needle (slow spread) (SEKI custom)	7,500-11,000	Slow Spread Moderate Intensity	18	H

This generalized vegetation continuum varies with changes in aspect and local microclimates (springs, riparian zones etc.). More extensive fires occur in drought years, with the fires spreading into areas normally too wet to burn.

Fuel models are simply mathematical models that describe the properties of live and dead vegetation that contribute to the physics of combustion. The models include parameters such as fuel weight, density, horizontal and vertical continuity, moisture content, and flammability. Fuel models are primarily used to predict fire behavior under different weather and environmental conditions. Currently the Fire Behavior Prediction System (FBPS) contains 13 standard fuel models. The park has created another two custom fuel models to locally describe fuel complexes not well covered by the standard 13 models. National Fire Danger Rating System (NFDRS) fuel models are also used to track seasonal drought and associated fire danger response planning.

The NFDRS fuel model B and Fire Behavior Prediction System (FBPS) fuel models 1 or 2, characterize the oak woodland vegetation. The NFDRS fuel models B or F and FBPS fuel models 4, 5, or 6 characterize the chaparral vegetation. The NFDRS fuel modes C, G or U and FBPS fuel models 2, 9, 8, 10 or custom model 14, characterize the pine dominated mixed conifer vegetation. NFDRS fuel models H or G and FBPS fuel models 8, 10, or custom model 14, characterize the white fir and sequoia dominated mixed conifer vegetation. NFDRS fuel model H and FBPS fuel models 8 or custom model 18 characterize the red fir forest. NFDRS fuel models H or U and FBPS fuel models 8 or custom model 18 characterize the lodgepole pine forest. NFDRS fuel models H or U and FBPS fuel models 8 or custom model 18 characterize the subalpine forest.

Wildland fuels are divided into dead fuel and live fuel types. The former is further divided into fine fuels (< 1/4 inch diameter), medium fuels (>1/4 and <3 inch), and heavy fuels (> 3 inch diameter). As the snow melts, dead fuels are usually saturated. As late as June, the heavy fuels have > 25% moisture content. During the next few months, they steadily dry until a fuel moisture of 7% is reached in late July or early August in the drier areas, such as Cedar Grove. This drying trend is usually followed by a slow increase in fuel moisture (due to humidity, etc.) until the winter precipitation begins. Live fuel moisture in the chaparral community tends to peak as the plants flower in the spring, exceeding 200% moisture content. Live fuel moisture tends to steadily drop as the summer continues, reaching approximately 50% moisture content. Similarly, annual grasses will cure by mid- June.

Fine fuels contribute mainly to fire spread. As the fuels dry out and the rate of spread increases, more of the heavy fuels may be ignited per unit time. Their localized energy produces more noticeable fire effects such as mortality, scorch, and char.

EFFECT OF FIRE SUPPRESSION ON WILDLAND FUELS

Dead fuel loads in the various vegetation types in the parks vary according to fire history, elevation, growth pattern, aspect, and length of growing season. The fire cycle, fuel load, and vegetation type are closely interrelated, and each fire type serves to stabilize and perpetuate a given community. Conditions produced from fire suppression have given rise to new fuel- vegetation complexes that influence fire type, which in turn affects the complex.

Years of fire suppression are thought to have effectively removed the mosaic of various aged burns in the vegetative communities below the red fir forest (< 8000 feet) and have encouraged more extensive fires than occurred prior to Euroamerican settlement. In the sequoia- mixed conifer and ponderosa pine types, fire acts as a thinning agent (Cooper 1960). In its absence, undergrowth of shade tolerant species results in a continuous ladder of all- aged crowns from surface to overstory. Crown fires, once virtually nonexistent in Sierra forests, are now possible (Kilgore and Sando 1975; Kilgore and Taylor 1979). The fires that occurred historically in the mixed conifer forest are thought to have been generally surface fires. A summary of the fire return interval for each vegetation type that occurs within the parks can be found in Chapter 9. Fire managers in the parks today use an index of how far an area has departed from the fire return interval that is thought to have existed prior to Euroamerican settlement (see FRID discussion in Chapter 4).

CONTROL PROBLEMS

During the peak of the fire season, fires in the oak woodland fuels are usually controlled early with suppression resources (ground and air) or they burn up into the chaparral fuels.

Fires in the chaparral fuels frequently are beyond direct attack capabilities at the head once they become established. These fires usually burn up to the ridge top and are caught, as they become backing and flanking fires in typically 3- 5 days.

Ponderosa pine- mixed conifer fires are often difficult to control during the peak fire season. Ladder fuels (manzanita and incense cedar) in the understory and numerous snags are the main cause of frequent short range spotting due to the torching of trees and rolling material in the receptive fine fuel bed. This fuel type is frequently located in a mid- slope thermal belt causing a longer period of active burning. The long burning period combined with the frequent spot fires can often exhaust initial attack resources leading to extended attack (2- 5 days).

Fires in the sequoia and white fir- mixed conifer types usually spread slowly through the compact litter layer and rarely escape initial attack. Heavy fuel loads, steep slopes, and long burning periods usually cause the few fires that go beyond initial attack. The heavy dead- and- down fuel and deep duff layer can lead to extended mop- up operations.

Fires in the red fir forest are rarely difficult to control due to the tightly compacted litter layer and slow fire spread. Fires occurring in the lodgepole pine and subalpine forest can usually be controlled due to the increasing amount of rock and bare ground as elevation increases.

FIRE MANAGEMENT HISTORY

Sources of fires

Thunderstorms account for an average of about 36 fires each year with most of these fires occurring in the mixed conifer type. Of the known lightning fires that have occurred in the parks from 1922 through the present, 95% of them have been less than 10 acres in size. Fire suppression has contributed to the preponderance of small fires; however, since the inception of the fire use program in 1968, approximately 89% of the fires being managed for resource benefit have been less than 10 acres. Most of these fires remained small because of low fuel loadings and natural barriers.

Lightning fire occurrence tends to increase with elevation up through the red fir type. Snags, ridge tops, prominent features, xeric sites, and the west- facing slopes are frequent sites of lightning fires. The ridges above Cedar Grove and Kern Canyon, the Sugarloaf Valley, and the western slopes of the Great Western Divide, are areas of frequent fire occurrence during periods of lightning activity (Vankat, 1985).

Human- caused fires may occur almost anywhere and at any time. Most are concentrated around roads, campsites, and trails. Many are the result of accidents such as carelessness with cigarettes or unattended campfires, whereas a few, such as the 2- acre Lost fire in 2001, are arson caused. Since 1922, approximately 45% of the fires in the parks have been human- caused, mostly in mixed conifer forests.

Fire Suppression

Little is known regarding fire suppression activity prior to the 1890 creation of Sequoia National Park and General Grant National Park (later expanded and renamed Kings Canyon National Park). Undoubtedly some level of suppression occurred by native peoples in pre- Euroamerican times, and there is some record of miners, sheepherders, and cattlemen extinguishing fires during their heyday beginning in the mid- 1850's. Lighter fuel loads and more open forests - a product of frequent pre- settlement fires - probably allowed some level of success to those early suppression efforts. During that period fire control was aided by cattle and sheep which grazed down dry grasses, further reducing opportunity for the rapid spread of understory and grassland fires in many areas. After park designation, a succession of military and civilian stewards continued to suppress most fires with the intention of protecting the big trees from harm. Suppression efforts became dramatically more effective and extensive following the advent of helicopter use in the 1940's and 1950's with full suppression of all fires remaining the official policy through the mid- 1960's. During the period of full suppression, fires became progressively more difficult, dangerous, and expensive to control due to the continued build- up of fire fuels across the landscape. During the 1960's research was systematically documenting the beneficial effects of fire on giant sequoia and other species, and recognizing fire as a keystone ecological process perpetuating Sierra Nevada ecosystems.

Since the 1960's it has been park policy to continue to suppress all human caused fires (except those intentionally set by park management) and many lightning ignited fires, while allowing some lightning ignitions to spread under carefully managed conditions.

Prescribed Burning

Concern about the impact of the parks' early fire suppression policy was first expressed for the middle elevation (4,000 to 7,000 feet) mixed conifer forest zone. The buildup of flammable ground fuels, the increase of white fir, the lack of giant sequoia reproduction, and the threat of wildfire to the sequoia groves all indicated the need to reintroduce fire into this zone by prescribed burning.

The prescribed burning program began in 1964 as an experimental research program to study the regeneration of sequoias. Drs. Richard Hartesveldt and Tom Harvey studied the regeneration of sequoias after several research areas were prescribed burned. They found that sequoia seed germination and seedling establishment is strongly related to disturbances of the substrate, the opening of the forest floor to light, and to the proximity of suitable substrate with trees of heavy cone loading (Hartesveldt and Harvey 1967). They also found that higher intensity fires produced even better conditions for seedling survival than light fires.

The experimental research program continued in 1968 when about 800 acres in a red fir forest were burned to study the ecological impact of prescribed fire on fir thickets (Kilgore 1971). Kilgore found that fire reduced the litter, duff, and humus by about 50% and killed many red fir seedlings and saplings. No adverse changes in deer, bird numbers, or water quality were observed.

Since the first experimental research burn in 1968 through 1999, an estimated 549 prescribed burns (49,771 acres) have occurred. For more information on the evolution of the prescribed fire management program see Bancroft et al. (1985).

Wildland Fire Use

Concurrent with the implementation of the prescribed fire program, the parks instituted a fire use program in 1968. Natural lightning ignitions managed to restore or maintain ecological conditions and processes have been variously known as "*prescribed natural fires (PNFs)",* "*natural fires*", and are currently called "*wildland fire use* (generally shortened to just *fire use*)". While the names have changed over time to conform to standardized interagency terminology, the intent and practice of managing natural ignitions have remained constant in these parks. Fire use projects in forested areas of the parks are generally slow burning, low intensity ground fires, which occasionally torch out individual trees, or make brief runs involving local crown fires. This type of fire is most common in higher elevations (> 8,000ft) due to the frequency of lightning strikes. In addition, the red fir, lodgepole pine, and subalpine forest communities found at high elevations are characterized by long- lived, widely spaced, and relatively short trees (Rundel et al. 1977). These forests are thought to have evolved with infrequent low intensity ground fires (Vankat 1970) due to the low temperatures and the short growing season. Because of the longer fire return intervals, these forest communities have not yet resulted in excessive fuel accumulations (Parsons 1977).

Due to the previous characteristics, most of the high elevation forests in the parks have been managed with a fire use emphasis over the last few decades. Since the beginning of the program, the parks have had 486 fires for a total of 42,460 acres. Most of these fires (89%) were less than

10 acres in size and only a few (6.5%) exceeded 100 acres in size. Fewer (2.1%) exceeded 1,000 acres in size. Most fire use projects have occurred in the red fir and subalpine vegetation types.

The largest fire use project in the parks, the Ferguson Fire, burned an estimated 10,420 acres. It started on June 26, 1977, and burned for over four months. It was finally extinguished by snow in November of that year. The period of 1976 to 1977 was one of severe drought in California.